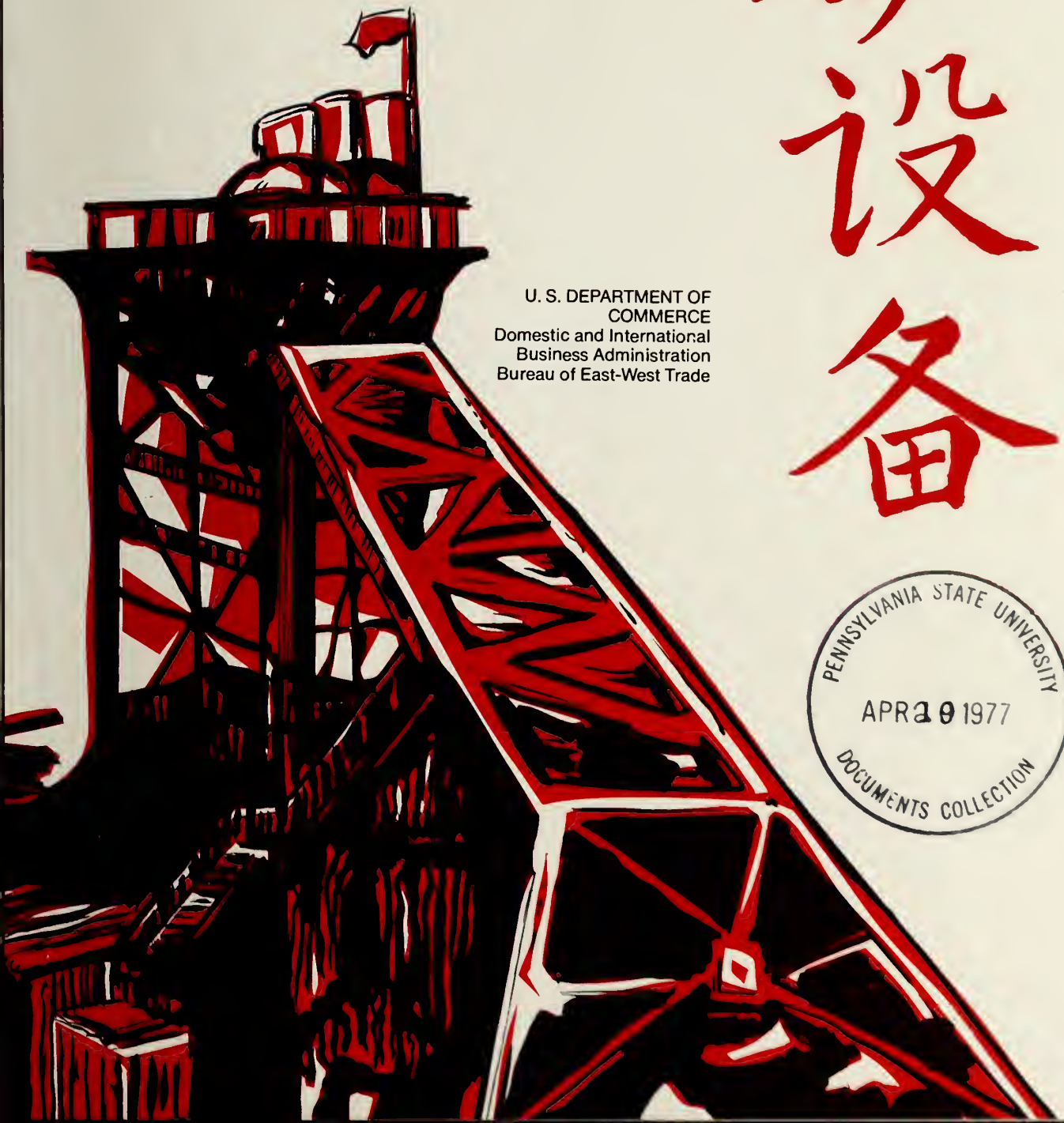
Coal Mine Equipment

A Market Assessment for the People's Republic of China

煤矿设备

U. S. DEPARTMENT OF COMMERCE
Domestic and International Business Administration
Bureau of East-West Trade



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Contents

Introduction

Objectives

This study of the coal mine equipment market in the People's Republic of China (PRC) is intended to provide interested U.S. firms with:

—A description of the basic characteristics of the market for coal mine machinery in the PRC.

—An evaluation of the apparent demand for foreign coal mine equipment and technology.

—An indication of the types of coal mine equipment offering the best export potential for U.S. firms.

Scope

This market research attempts to provide an indication of the potential market for all types of machinery employed in the mining and preparation of coal. Examples of the kinds of machinery covered include but are not limited to:

SITC No. 718.42 (excavating, leveling, boring, etc., machinery)

- Augering machines
- Boring machines (for earth, coal, rock)
- Blades for coal cutters
- Bulldozers
- Coal-cutting machines
- Coal-stripping machines
- Cutter bars (for coal cutters)
- Cutting chains (for coal cutters)
- Cutting machines (for coal, earth, rock)
- Drag lines
- Drilling machines (for earth, coal, rock)
- Excavating machines
- Scraper machines (earth)
- Shovels (mechanical)
- Tunneling machines

SITC No. 718.51 (mineral crushing, sorting, etc., machinery)

- Cleaning machines (for solid mineral materials)
- Coal-crushing machines
- Coal-sorting machines

SITC No. 719.31

- Conveyor belts
- Tipping machines.

Analysis

This is primarily a sectoral analysis of China's coal industry and related equipment needs. A rather broad approach to understanding the market is made necessary by the lack of sufficient data to permit a more refined assessment of China's coal mine equipment needs. It should be noted that China has published no significant production or trade data on a regular basis since 1960. This means that the figures on the Chinese economy used in this study are practically all estimates. Further hindering a detailed determination of China's coal mine equipment needs is the fact that it is not possible to determine the range of such equipment China has imported since equipment clearly destined for coal mine use is seldom separately identified in published trade data.

The sources of information used in the study include Chinese publications, such as monitored radio broadcasts, press reports, reports by visitors to China, third country trade statistics, and other reports available to the U.S. Government. Informational coverage of the 1950's, when China was building the base of its coal industry's development, is rather comprehensive. The best single sources are two Chinese industry journals [1] and a detailed report [2] by Soviet coal mine experts who had worked in Chinese coal mines for several years. For the period since 1960, information emanating from China has been limited to occasional sketchy reports of new machinery developed, coal output for sections of the country or on a national basis stated in percentage terms in relation to previous time periods, and reports of contacts between Chinese and foreign coal mine specialists and delegations.

The report indentifies trends in China's coal production and discusses the role of coal in the total energy supply. A review of the development of China's coal mine equipment industry, the major kinds of equipment it is apparently capable of producing, the pattern of its foreign purchases, and its expressions of interest in foreign equipment are important aspects of the analysis. As the demand for coal mine equipment is largely a function of coal output, China's coal output is projected over the next 5 years. Factors influencing the kinds of equipment China may be interested in purchasing from abroad also are touched on. These include the mining methods employed and the slope and depth of the seams.

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[1] *The Coal Industry* (in Chinese) and *Coal Mine Technology* (in Chinese).

[2] *The Coal Industry of the People's Republic of China* (in Russian), Moscow, 1959.

Conclusions

There is a potential market in China for U.S. coal mine machinery and equipment. Since 1949, China has purchased significant amounts of coal mine machinery abroad, concentrating such purchases in the 1950's in the Soviet Union and Eastern Europe, but later in Western Europe and Japan. After stagnating in the 1960's China's purchases of foreign coal mine machinery have revived to some extent. China has ordered over $100 million worth of foreign coal mine equipment since 1972.

Despite the noteworthy achievement of becoming the world's third largest coal producer (427 million metric tons in 1975), China must make still greater efforts to meet the economy's growing demand for energy. Dramatic increases realized in oil and gas output over the past few years do not signal the rapid demise of coal as the major energy source for the Chinese economy. Transporation difficulties, technological bottlenecks, scarcity of capital, the policy of making all possible use of local resources, and strategic military considerations will cause China's switch to oil to be less rapid and as widespread than might otherwise be expected.

China's purchases of foreign coal mine machinery will include underground, open-pit, and coal preparation equipment. Underground equipment purchases will come mainly in the area of complete face extraction systems, featuring self-advancing hydraulic roof supports, shearers, conveyors, lighting, and communications equipment. The coming decade should see the Chinese advance further into open-pit mining with increased mechanization, implying purchases of large trucks, blasthole drills, power shovels and draglines. Continued growth in the steel industry and the need to mine and process increasingly poor grade coking coal may lead to Chinese purchases of more advanced coal preparation equipment. As a major advocate of the hydraulic system of mining, China may be interested in considering the technical capabilities of foreign designed and produced hydraulic mining equipment.

If China shifts the emphasas of its coal mine development strategy toward greater reliance on large mine development with correspondingly less effort in small mine construction, then the outlook for sales of coal mine equipment will be much improved. The possibility of such a shift is indicated by the recent adoption of a long-term national coal production plan in which mechanization is stressed and by the growing power of "moderates" who attach great importance to upgrading technology. However, the number of small mines will in any event continue to have an important role, given China's limited capital and transportation system.

Coal Mine Equipment Market Analysis

Import Policy

It is China's policy to be self-reliant and not to become dependent on imports. Chairman Mao has said, "Build our country independently and with the initiative in our own hands, through self-reliance, hard struggle, diligence, and thrift." But it is also Chinese policy to import foreign equipment and technology. As the Minister of Foreign Trade has said, "China welcomes technical interchange with other countries and imports essential equipment on a planned and selective basis according to the needs of her socialist construction."

The China Council for the Promotion of International Trade states that technological imports would even be conducive to self-reliance. In a recent publication the Council states: "China imports some new equipment and technology that are needed in carrying out the policy of being more self-reliant and speeding up the building of socialism." Although there is some opposition in China to foreign imports, Chinese authorities have made it clear that China's continuing policy calls for the imports of some foreign technology and equipment.

Under the new leadership of Hua Kuo-feng, China will continue to develop foreign trade. The Minister of ForeignTrade informed a visiting U.S. trade delegation in October 1976 that China's foreign trade policy had not changed and that U.S.-China trade would continue to develop, adding that it would develop even more quickly when our bilateral relations are normalized. The threat of a diminished role for trade posed by the "radicals" has receded.

Market Potential

Demand for coal mine equipment in China is assumed to vary directly with changes in total coal output. Considering factors affecting the demand for coal, including the growth of industrial and household requirements as well as the substitution effect of increased use of oil and gas, it is assumed that coal output will grow by 6 percent through 1980 and by 5 percent from 1981 through 1985 (Table 7). Demand for coal mine machinery should grow at faster rates as the mechanization drive gains momentum. Chinese coal mines will of course obtain the great bulk of their equipment needs from domestic manufacturers. Shortfalls in domestic manufacturing schedules and the desire to selectively upgrade technology through importation of foreign equipment, however, should lead to continued purchases of foreign coal mine equipment.

On the assumption that China's coal output will increase by the above rates, China will add roughly 300 million tons of new coal output in the period, 1976-85. Perhaps a third of this increment, or 100 million tons, can be supplied by small mines wholly equipped with locally manufactured equipment. Larger, more mechanized mines, must add 200 million tons in new coal production. In the past, China has imported substantial amounts of foreign equipment when large increments to capacity have been required. This has been the case though noteworthy increases in PRC production of mining equipment have been achieved. Thus, despite a reported fourfold increase in the production of mining equipment between 1965 and 1973, China contracted to purchase over $100 million worth of foreign mining equipment during this period.

Compilation of a list of actual shipments of coal mine machinery to China to date would provide an excellent indication of the nature and potential magnitude of Chinese interest in such equipment. Because the data published by China's trade partners do not itemize coal mine equipment as such, however, this is not possible. An alternative approach is to examine publicly announced sales of coal mining equipment to China (Table 1). This approach points to a potential market in China for coal mine equipment

Chinese interest in foreign coal mine machinery may also be inferred from the renewed emphasis now being given to speeding up the modernization of the economy in general and the coal industry in particular. At the Fourth National People's Congress held in January 1975, Premier Chou En-lai enunciated China's determination to advance rapidly to the front ranks of the industrialized countries by the

Table 1.—*PRC Purchases of Coal Mine Equipment, 1972-74*

Equipment	Remarks
8 sets of longwall equipment, including: 1,000 longwall roof, supports; double-ended ranging boom shearer and conveyor equipment; electric panels for operating face equipment; electric cables; transformers; face communications and signaling equipment.	Sold June 1973 by Gullick Dobson (Export), Ltd., U.K., (main contractor and supplier of roof supports). Other suppliers: Baldwin and Francis, Ltd. (electric panels); BICC, Ltd. (electric cables); Brush Transformers, Ltd., (transformers); John Davies, Ltd. (face communications and signaling equipment). Value: $12 million.
13 sets of longwall equipment, including: armored coal face conveyors and drives, gate belt conveyors and stage loaders; 13 sets of 4-leg 280-ton and 4-leg 250-ton roof supports; power-loading machinery; face-lighting and signaling equipment and switchgear.	Sold July 1973 by Dowty Group, U.K. (main contractor and supplier of roof supports, armored conveyor, and loaders). Other suppliers: Anderson Mavor, Ltd. (power-loading equipment: 17-in. AM Mk. 2 double-ended ranging drum shears powered by 2 water-cooled 200 kW electric motors and fitted with FIDD boom gear head units); BICC (6.6 kVA armored supply cables and 1.1 kVA trail cables and couples); Brush Transformers, Ltd. (transformers: 150, 500, and 300 kVA types); Baldwin and Francis, Ltd. (switchgear for power loaders and conveyor and stage loaders). Value: $30 million.
Mechanized coal face equipment.	Sold 1973 by Machinenfabrik-Zhermann Hemscheidt (West Germany). Value: $14 million.
4 sets of equipment for working coal seems less than one meter thick.	Sold in 1974 by Dowty Mining Equipment, Ltd. led consortium of U.K. suppliers. Payment over 5 years. Value: $5.18 million.
Mechanized coal face equipment.	Sold in 1974 by Gutehoffnunghuette Sterkrade A.G. and A.E.G. Telefunken (West Germany). Value: $8 million.
Coal mining machinery.	Sold 1972-74 by Poland. Value: $25 million.

end of this century and to build "an independent and relatively comprehensive industrial and economic system. . . before 1980." At a coal industry conference held later in the year, the minister of the coal industry ministry echoed Premier Chou's call in announcing a 10-year program for achieving rapid mechanization of the coal industry. These events suggest that increased coal output has been accorded a high priority in the next 5-year plan, including the possibility of priority access to foreign exchange to purchase needed equipment. This possibility is supported by another national coal conference in November 1976 which strongly implied the need to import foreign coal mine machinery.

China has the potential to generate the necessary foreign exchange to purchase substantial quantities of coal machinery abroad. China's foreign trade has grown significantly in recent years, rising in current dollars from $3.86 billion in 1969 to an estimated $15.43 billion in 1975. Export earnings may be buoyed in the near term by increasing sales of oil. As recently purchased complete plants (fertilizer, petrochemicals, steel) come on stream, blocks of foreign exchange previously allocated to the purchase of these commodities will be freed for the purchase of capital goods. A surplus of imports for the years 1974 and 1975 had been basically corrected by 1976, but import growth may be restrained until 1978 or 1979 due to the foreign exchange outflow required to pay for the cluster of plants purchased in the period 1973-75.

China may wish to increase coal exports as another means of enlarging its foreign exchange earnings. With reserves adequate for centuries of domestic use, Chinese planners could decide that the export of coal poses no long-term danger to the economy and, if the price of coal is attractive enough, undertake steps preparatory to expanding coal exports. A number of countries, some on a regular basis, already purchase small quantities of Chinese coal. Japanese utilities and steel mills in particular constitute a large potential demand and,

in fact, China has begun to export steam coal to Japan on a modest scale. Japancse importers have indicated the possibility of increasing imports of Chinese steam coal, which is low in sulfur, provided China can assure an adequate long-term supply of desired grades. This prospect may be most efficiently realized through the creation of new export-oriented mines, coal preparation plants, and transport facilities, which themselves may generate demand for foreign equipment.

Coal Industry Activities

The importance attached to increasing coal production is clearly indicated by recent events and trends in China, most recently by the national coal conferences of November 1976 and January 1977. The national leadership issued a directive in 1974 addressing the problem of lagging production in a number of mines and provinces. January 1975 saw the recreation of the coal ministry, and a national coal conference was convened by that ministry later in the same year at which a 10-year plan for increasing coal output was unveiled. Long-term plans have been announced by individual mines and the opening of more new mines has been announced. New coal mine machinery has been put into production.

In July 1974, Chairman Mao reportedly approved the issuance of Central Directive Number 21 calling for, among other things, urgent attention to correcting the problem of lagging production of coal in certain mines and regions. The document noted that national coal output in the first 5 months of the year had fallen 8.35 million tons below the planned level and that this decline in output had adversely affected the steel, fertilizer, and cement industries. Although the shortfall was limited to a few mines and provinces and probably was corrected later in the year, the prompt attention the highest level of the leadership gave the problem indicates the key importance of coal in the national economy and the unacceptability of any shortfall in coal output.

In January 1975, the Ministry of Coal Industry reemerged as an independent agency in the central government. The coal ministry had formerly existed but had been absorbed in 1966 by the Ministry of Fuels and Chemicals. The new minister of the recreated coal industry ministry was Hsu Chin-chiang,, who had been identificd with the successful development of the Ta-ching oilfield. The reestablishment of the coal ministry and the appointment of Mr. Hsu suggest a desire to overcome lagging production and restore earlier growth rates. Mr. Hsu died in 1976; a successor has not yet been named.

The new coal ministry convened a national coal industry conference in Peking in October 1975 at which Minister Hsu announced the industry's 10-year plan to increase production and raise efficiency. Attended by over 5,000 people, including officials and mincrs from all parts of the country, the conference, itself, served notice to the industry of the urgency the leadership placed on the goal of more coal.

Minister Hsu exhorted the conference to bring development of the industry to an "unprecedented level" through 10 years of hard work and to provide sufficient coal for the rapid development of the national economy. To achieve this goal, Minister Hsu stated that the industry must follow the party's general line for building socialism and work in the spirit of self-reliance and hard struggle, and in addition must:

- tap the potential of existing coal mines
- complete the coal mines now under construction as soon as possible
- transform and develop small mines
- build several large coal mining centers
- greatly increase the per-unit output, tunneling footage, and recovery rate
- strive for basic mechanization within 10 years

Hsu emphasized that increasing per-unit output, tunneling footage, and recovery rate were the most effective ways of increasing production and that these methods would be utilized both in tapping the potential of existing mines and in building more new mines. Such emphasis suggests that more efficient coal mine machinery will be called for on an urgent basis. The 10-year plan for mechanization was divided into two phascs coinciding with the current and next 5-year plans. In the first phase, general mechanization of the major mines with comprehensive mechanization in certain major areas is the goal, while in the second phase, comprehensive mechanization in all areas is the objective.

Reflecting the current emphasis on increasing production, new mine construction has apparently speeded up in recent months and may continue at a higher pace throughout the current 10-year plan if, as seems likely, new investment funds have been earmarked for this purpose. China announced that more than 60 pairs of coal mine shafts were constructed in 1974, that 22 pairs of shafts were completed and put into production in the first half

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of 1975, and that 32 new shafts were opened in the first 8 months of 1976. Announcements for specific new mines provided information on size and location and indicated that some of them, including open-pit units, are of medium to large size (300, 000 tons per year and over) and are widely dispersed geographically, with the southwest and northwest areas of China accounting for a substantial portion of them. The pattern of new mine development demonstrates that coal remains a key factor in the economic development plans of many emerging industrial centers.

In recent years a number of individuals mining administrations have announced long-term production plans. The Ta-tung Mining Administration of Shansi province in September 1974 put into effect a 10-year plan expected to triple coal output which, if realized, will give Ta-tung's mines an output of some 60 million tons by 1985, almost equal to Shansi province's total current output. The Kailan mining administration successfully completed a plan to double the original designed output within the Fourth 5-year Plan with the announcement that it had produced over 25 million tons of coal in 1975. The July 1976 Tangshan earthquake is believed to have caused serious damage at Kailan but production had been partially restored by the end of the year. Fukien province has announced a plan to achieve self-sufficiency in coal supply by the end of 1980, which should further reduce the south's need to import coal from the north. These plans indicate that the mining administrations are under increasing pressure to expand production and are taking steps toward its achievement.

Rising concern for increased coal production has also manifested itself in the new coal mine machinery recently deployed in China. China has announced that it has successfully designed, manufactured, and employed a number of highly productive machines, including cylindrical continuous miners, large-diameter boring machines, hydraulic roof supports, and jet-flow flotation coal preparation machines. China has also imported a range of advanced foreign equipment consisting mainly of complete sets of longwall equipment. While the state-of-the-art of China's domestically produced equipment appears to lag that of the most advanced foreign designs, China has mechanized several mines to a high degree and manufactures a large range of mining equipment, much of which is close to international standards. The PRC appears to intend to expand its inventory of equipment to include types not now produced and to increase the productivity of models already in production.

Purchases Abroad

China's recent coal mine machinery purchases (Table 1) indicate a strong interest in longwall face equipment. The current round of purchases began in 1973 with the purchase from the United Kingdom of a number of complete sets of longwall face equipment, including face-cutting, conveying, hydraulic roof support, and signaling equipment. China has purchased West German and Polish coal mine equipment in substantial quantity.

Technical exchanges have played an important role in these transactions; the British case is an excellent example. Several Chinese coal delegations have visited the United Kingdom over the last 3 years, inspecting both mines and factories. In early 1973, a team of 20 Chinese engineers visited Britain's Dowty Mining and Dowty Meco Companies and toured mines using their equipment. Further discussions were held with the firms' representatives at the British Industrial Exhibition in Peking in April 1973 followed by detailed negotiating and a Dowty announcement in August 1973 of a contract in excess of $30 million for longwall miners.

Exhibitions play a role in sales of mining equipment to China. Dowty's first direct contact with the Chinese was through an exhibition held in 1964 by British mining equipment manufacturers. Sweden sold China about $20 million worth of mining equipment in 1967 at an industrial exhibition in Peking. Poland, which regularly has sold China equipment for coal mining, held an exhibition in Tientsin in 1974. West Germany, too, reportedly sold mining equipment at its industrial exhibition in Peking in 1974. While details of sales from exhibitions are not known, the many reports of such sales indicate that the Chinese are receptive to buying mining equipment at such exhibitions.

PRC participation in recent international coal mining conferences is another indicator of China's renewed interest in coal mine development. In 1975, the Coal Society of China sent a delegation to the United States to take part in the Sixteenth International Conference of Coal Mine Safety Research where they delivered a paper and visited a leading American coal mine safety equipment manufacturer. China also participated in the Ninth World Mining Conference in West Germany in May 1976 where several papers on technical and other aspects of China's coal mine activity were given.

Sectoral Analysis

Coal Mining Equipment Industry

The Chinese are capable of manufacturing the basic equipment needed for the mining and processing of coal. This capability, which did not exist in 1949, represents an impressive economic achievement. Prior to 1949, capabilities were limited largely to repair, assembly, and spare part manufacture principally in Sheyang, Harbin, Fushun, Anshan, and Changchun. The largest of these plants, around which the new administration initially concentrated its reconstruction efforts, were in Anshan and Fushun.

By 1960, China possessed about 100 widely dispersed mine-machinery manufacturing plants, in addition to numerous repair centers; at present that number may well have doubled. Major coal industry equipment manufacturing plants and their principal products are shown in Table 2. The production of mining equipment apparently is directly controlled by province and lower level administrative units, but with guidance from one or more of the several machine building ministries and the coal ministry. Given the widely dispersed nature of China's coal deposits and the drive for maximum local self-sufficiency, it is likely that every province has developed a capability for producing some coal mine equipment and of repairing and servicing it.

China's coal mine equipment inventory reflects the influence of several nations, as well as a growing, purely Chinese element. Equipment inherited in 1949 was practically all from the United States, Western Europe, and Japan. The influence of American equipment had been particularly strong in the open-pit area, especially power shovels. In the 1950's, Soviet influence became dominant, as Soviet advisors helped China establish coal industry machinery plants to produce equipment using Soviet designs. The exodus of Soviet advisors in 1960 forced China to rely more on its own efforts and inventiveness and to renew imports from the West and Japan.

With this background, it is not surprising that the level of Chinese coal industry technology and the degree of mechanization is uneven and difficult to gauge in terms of China's current needs. In general, the larger mines are much more mechanized than the smaller ones. Currently, the large mines appear to be the only recipients of imported machinery. The technology level of equipment used in the large mines, while perhaps adequate in many respects, is generally below that used in comparable mining or beneficiating processes of the advanced Western nations. There are exceptions, such as hydraulic mining, where the Chinese may have made special efforts. The policy of local self sufficiency appears to have resulted in the simultaneous development of new technology and machines at various places, a procedure in some respects wasteful. The Chinese have succeeded, however, in creating a strong mining equipment manufacturing base.

The primary deficiency of the Chinese coal industry equipment lies in its technological lag with respect to certain types of machinery. The Chinese apparently still do not produce many varieties of large trucks (largest is 60 tons), front-end loaders, power shovels, bulldozers, and scraper-loaders used in highly productive mixes in American open-pit coal mines. Some of the most productive types of machinery used in longwall coal extraction, including the plow and shearer with connecting conveyor system and self-advancing hydraulic roof supports, apparently are not yet serially produced in China. High capacity load-haul-dump rubber-tired vehicles have not been produced in China nor introduced into China's coal mines.

Continuous Miners

China now manufactures a variety of continuous mining machines, an excellent achievement in view of the complete absence of this type of machine in the pre-1949 period. The first continuous miners employed in China were imported Soviet Gornyak and Donbass models. In the late 1950's, China began to manufacture these designs, or modifications of them, in its own plants. These were relatively simple

Table 2.—*Plants Producing Coal Mine Equipment in China*

Plant and/or Location	Equipment Produced
Chihsi (Heilungkiang Province).	Cutter-loaders, rock-loaders, drilling machines, coal-loaders.
Chingchow Mine Equipment Plant (Liaoning Province).	Metal supports, overhead beams, supporting tresses.
Chun-li Machinery Plant (Harbin, Heilungkiang Province).	Coal preparation equipment.
Dairen (Liaoning Province).	Electric trolley locomotives (first batch based on Soviet design, 7 KR, with 250-volt engine).
Fushun (Liaoning Province) several plants, including: Fushun Coal Mine Machinery Plant. Fushun Coal Mine Safety Machinery Plant.	Scraper conveyors of Soviet types SKR-11, SKR-30; chain conveyors, belt, conveyors, drilling machines, shaker feeds for hoppers, coal tubs, electric motor for Donbas-1 and Gornyak cutter-loaders. Power shovels. Gas meters. Roof pressure guages.
Hsia-men Mining Machinery Plant (Fukien Province).	Mining drills.
Hsiantan.	Electric locomotives.
Kailan (Hopei Province).	Electric locomotives.
Kalgan (Hopei Province).	Conveyors.
Kan-chan Mining Machinery Repair and Manufacturing Plant (Kiangsi Province).	Conveyors.
Loyang Mining Machinery Plant (Honan Province).	Hoists (up to 9-ton cap.), vertical tunneling equipment, large-flotation machines.
Shanghai, various plants, including: Shanghai Mining Machinery Plant, Shanghai Heavy Machinery Plant, Shanghai Coal Mining Machinery Plant Research Institute.	Hoists, belt and scraper conveyors, shuttle cars, crushers and vibration screens, water pumps, electric motors, tunneling machines.
Shenyang (Liaoning Province) various plants, including: Shenyang City Crane and Conveyor Plant.	Coal and rock loaders; conveyors.
Shenyang Mining Machinery and Equipment Plant.	Spare parts for mining equipment.
Shenyang Pump Works.	Water pumps for mines.
Shenyang Pneumatic Tool Plant.	Rock drills, pneumatic picks.
T'ai-yuan Mining Machinery Plant (Shansi Province).	Shovel loaders (4-8 m3), compressors, other equipment.
Tatung (Shansi Province).	Continuous miners.
Tientsin City Motor Vehicle Plant (Tientsin Municipality).	15-ton dump trucks for mining.
Tientsin Coal Mine Machinery Plant.	Coal preparation equipment; conveyors.
Tsinghai General Machinery Plant (Tsinghai Province).	Rock loaders; shovel loaders (8.25 m3).
T'ung-hua Mine Machinery Plant (Kirin Province).	Coal mine machinery.
Liaoyuan Coal Mine Machinery Plant (Kirin Province).	Cutter-loader for thin seams (Chinese designed especially for thin seams in southern China).
Ch'ang-ch'un Motor Vehicle Plant (Kirin Province).	60-ton dump truck (trial production 1976).
Chang-chia-kou Coal Mine Machinery Plant.	Chain conveyors.
Nan-shan Coal Selecting Plant (Heilungkiang Province).	Coal preparation equipment (China's first "jet flow" coal dressing machine built here).
Shih-chia-chuang Coal Mine Machinery Plant (Hopeh Province).	Drills.
Huai-nan Coal Mine Machinery Plant (Anhwei Province).	Electric motors, including 155-kW, 110-kW, and 75-kW slip ring mootrs, 40-kW, 7.5-kW, and 2.2-kW safety motors; 90-kW minature motors.

machines, and by the early 1970's, China had begun to manufacture from its own design more productive, cylindrical drum-type continuous miners, including some models with two heads. China has also designed drum-head continuous miners especially adapted to coal seams of various seam widths and angles of dip. Shearing and cutting devices (plows and saws) drawn by steel rope across the coal face are now being produced. China has also designed and produced a few sets of equipment integrating the cutting, loading, transport, and roof control functions. A continuous miner designed to operate in seams less than a meter thick common in South China has been in serial production since 1971.

The number and kinds of continuous miners in inventory and now being produced annually is not known. The amount of coal being mined by continuous mines also is not known. In 1952, there were only 4 continuous miners, increasing by 1958 to 257, all of Soviet design. In 1958, only 5 percent of coal mined was accomplished with continuous miners.

Relatively little is known about the technical characteristics of China's continuous miners. The Donbass/Gornyak-type requires one or two miners to operate and recover about 100 tons of coal per hour. In 1958, however, the monthly output per machine averaged only about 8,000 tons. This may have resulted from the fact that only about one-third of the machines then operable were used, indicating perhaps some difficulty in maintenance or assimilation of the new technology involved. Major modifications of these machines included extending the hinge bar to 2 meters and increasing the power of the electric motor to 65 kW and the loader motor to 35 kW.

The cylindrical head continuous miners were much more productive, one good example being the double-headed model manufactured by the Chi-hsi Coal Mine Machinery Engineering Plant. In a seam sloping up to 25 degrees and from 1.4 to 2.2 meters thick, this machine, head diameter 1.0 meters, makes a cut 0.6 meters into the seam and recovers from 180 to 280 tons of coal per hour.

China apparently employs steel rope-drawn cutting devices mainly in thin seams. The plow (shearing type) method uses two winches pulling the plow back and forth across the face at a high speed. This method is capable of extracting 800 to 1,000 tons of coal per shift. In seams with great angles of dip China has successfully employed steel rope-drawn hexagonal saws placed 1 to 2 meters apart.

Cutting Machines

Before 1949, undercutting machines were seldom employed in Chinese coal mines, and even by 1958 their use was associated with only 5 percent of total coal output. In 1959, there were only 475 cutting machines in China, all of which were imported or made in China based on the Soviet model, KMP-1. Chinese-made cutters made up only a little more than one-fifth of the total inventory, which in 1959 consisted of the following:

Type	*Number*
Chinese-made, based on Soviet model KMP-1	95
Soviet-made, model KMP-1	133
Soviet-made, model KMP-2	131
Soviet-made, model GTK-35	5
Soviet-made, model PM6-2	9
Polish-made, model WLE-40	67
Polish-made, model WLE-80	14
Polish-made, model SBKE-40	10
Japanese-made	11
Total	475

Later information on cutting machines in China has not been published, but it is reasonable to assume that the production of cutters has greatly increased given the continued prevalence of the drilling and blasting method of mining.

Tunneling Machines

Tunneling through rock and coal was accomplished traditionally by drilling and blasting and handloading of rock and coal. Tunneling machines used in 1957 were of Soviet design, including models RP-17, OM-507, and PM-508. In 1957, the Soviet RK-2M was introduced, and by the end of 1959, China's inventory of tunneling machinery had expanded to include 150 Soviet model EPM-1 rock-loading machines and several complex tunneling-loading machines of the Soviet PK-2 type.

Information released on production of tunneling equipment manufactured in China since 1960 has been meager, a major exception being the announcement in the latter half of 1974 that China had successfully manufactured a large vertical-shaft borer. The diameter of the drill bit is 7.4 meters at its widest part and that of the drill rod, 400 mm. The derrick is 40 meters high and weighs 110 tons. Immediately after a hole is drilled with this machine, prefabricated ring-shaped walls are sunk into the hole. The Chinese claim that the design work for this 300-component machine was started in late 1970 and finished in 3 months. Eight scientific research units participated in the design work and over 100 Shanghai plants supplied components for manu-

tacture of the machine, probably assembled at the Shanghai Mining Machinery Plant. The initial unit has been in trial operation since November 1972 at the Tatung mine in Shansi.

Other Chinese boring and loading machines are known, but with less detail regarding specifications. They include a 1971 rock tunnel boring machine with a boring diameter of 3.8 meters manufactured at the Fushun Coal Mine Machinery Repair Plant and a tunneling machine of 3 meters diameter reported in production at the same time at the Shanghai No. 1 Petroleum Machinery Plant. Both machines apparently employed the same technology of shearing the entire face with a cutter head incorporating multiple disc cutters.

Drills

Given the predominance of drilling and blasting techniques in coal mining, the drill occupies an important place in China's inventory of coal mining equipment. In 1958, a year in which over 65 percent of all coal extracted was drilled and blasted, the drilling was done with an inventory of 9,090 electric drills of all types. As of 1958, the most commonly used electric hand drills were the Soviet types ER-4, ERP-5, and EBR-19D. China's demand at that time for hand drills was met by production from only three factories.

Quantitative information on the production of drills and drilling machines since 1958 has not been published, but in 1966 the production of a new crawler drill was announced. This machine, the "Tung-feng 200," was reported to have the following specifications:

Diameter of drill	200mm
Depth of boring	15m
Angle of boring	60°–90°
Diameter of rod	152m
Rotational frequency	40vpm
Travel speed	1.2 km/h
Climbing capability	15°

Underground Transport Equipment

Conveyors and electric locomotives now constitute the main components of China's underground coal transport system. In the newer modern mines the typical pattern of operations involves the removal of the coal away from the face by "scraper" conveyors to belt conveyors which in turn deliver the coal to electric locomotive pulled trains in the main haulage ways. The scraper conveyor is most productively used as a bridge between continuous miners at the face and belt conveyors leading to main haulage ways. In older mines, rope haulage is still much used.

The trickle of information released by China indicates that substantial progress continues to be made in upgrading its underground haulage system, which was formerly a weak link in its mechanization chain. A recently developed belt conveyor is said to reach a length of 2,650 meters and possess the capability of transporting 360 tons of coal per hour. More common belt conveyors of 300 meters length can transport 100 to 200 tons of coal per hour. The use of electric locomotives has spread to all modern mines. The capacity of mine cars has been enlarged to 1 to 4 tons capacity and fully loaded trains attain a speed of 10 kilometers per hour. The capabilities of vertical shaft lifting winches has increased to the point where 500 kw winches now lift 2,000 tons of coal from a depth of 500 meters during the course of a typical 2-shaft (14 hours) day.

Open-Pit Machinery

China employs a wide range of equipment in its open-pit coal mine operations, including almost all of the major types of equipment used in U.S. open-pit mines. In general, Chinese equipment is smaller in size than similar U.S. equipment, and China's equipment inventory contains a much smaller proportion of large trucks, front-end loaders, scraper-loaders, and conveyors.

The pattern of mechanized open-pit operations established in the 1950's involved blasting of overburden, stripping of overburden, and coal by dragline or shovel, and transport by locomotive drawn dump-cars. Overburden and coal were frequently lifted to the surface in tubs drawn by powerful wenches. Front-end loaders and trucks have been introduced into open-pit coal mine operations in China but their small size and scale of production has limited their use. Tables 3 and 4 contain information on types of shovel-loaders and dump

China has made progress in the manufacture of large excavating equipment, especially the electric power shovel, but Chinese excavators are smaller and less diversified in design than those in common use in the United States. Apparently China's draglines are simply specially fitted power shovels; large wheeled excavators have not been used or produced. Production of power shovels in China did not begin until the 1960's. At the end of 1958, four-fifths of China's excavating inventory of 142 power shovels were imported from the Soviet Union and the rest were older American and Japanese models. The

Table 3.—*Dump Trucks Manufactured in the PRC*

(selected models and specifications)[1]

Model	*Curb weight (metric tons)*	*Payload (metric tons)*	*Engine*	*Manufacturing plant*
Liberation (Chieh-fang) CA-340	4.2	3.5		Szu-p'ing Municipal Machinery Plant
Nan-Yang 351	7.0	7	Diesel 160 hp 2000 rpm	Nan-yang Motor Vehicle Plant
Yellow River (Huang-Ho) QD-351	7.6	7	Diesel 160 hp	Tsingtao Motor Vehicle Manufacturing and Parts Plant
Communication (Chiao-t'ung SH-361	13	15	Diesel 6 cyl 220 hp 2200 rpm	Shinghai Truck Plant
Shanghai SH-380	22	32	Diesel 12 cyl 400 hp	Shanghai Truck Plant

[1] Unless otherwise specified, all are serially produced, wheel type.

average size of the mining power shovels in 1958 was 2.7 cubic meters. The number of large shovels produced since 1958 is not known, but a Chinese source indicates that China now manufactures electric mining shovels of 4-, 6-, and 8-cubic-meter bucket capacities.

Transport of overburden and coal is still handled primarily by electric and smaller steam locomotive pulled trains of self-tipping dump cars. The cars have capacity of 50 to 60 tons and the locomotives range in size from 80 to 150 tons. In 1958, the most commonly used locomotives were in the 80- to 85-ton class. The great majority of dump cars were of 60-ton size and were made in Talien. The 50-ton cars in use were Soviet made. The Talien cars had a tare weight of 35 tons. The average train carried 274 cubic meters of coal or overburden per trip and transported a total of 1,699 cubic meters of material per day. A little over a third of the track (wide gauged) was movable and cranes were used to relay 80 kilometers of track per month at the large Fushun and Fuhsin pits.

Table 4.—*Shovel Loaders Manufactured in the PRC*

(selected models and specifications)[1]

Model	*Type*	*Machine weight (metric tons)*	*Shovel capacity*	*Lift capacity (metric tons)*	*Lift height*	*Machine dimensions*	*Manufacturing plant*	*Other*
0.5 cu.m.	Hydraulic	4.2	0.5 m^3 (0.65 $yd.^3$)	1.2	2.2m	4.2m. long 1.3m. wide 2.4m. high	Shanghai Municipal Transport Company	With forklift attachment
#7015	Hydraulic	7.0	0.82m^3 (1.07 $yd.^3$)	2.05	2.4m	5.6m. long 2.0m. wide 2.75m. high	Tientsin Municipal Transport Company	
A83-17B	Hydraulic	5.9	0.8-1m^3 (1-1.3 $yd.^3$)	1.7	2.5m	5.4m. long 2.2m. wide 2.6m. high	Peking Municipal Transport Company	
Red Flag D632	Hydraulic	6.3	1m^3 (1.3 $yd.^3$)	1.7	4.2m	5.5m. long 2.3m. wide 2.7m. high		
DC-17	Hydraulic	6.5	1m^3 (1.3 $yd.^3$)	1.7	2.5m	5.1m. long 2.2m. wide 2.5m. high	Shanghai Municipal Transport Company	
YDC-20	Hydraulic	5.8	1m^3 (1.3 $yd.^3$)	2	4m	5.5m. long 2.2m. wide 2.3m. high	Shanghai Municipal Transport Company	
Z4-4	Hydraulic	6.9	1m^3 (1.3 $yd.^3$)	2	2.3m	5.6m. long 2.2m. wide 2.8m. high	Tientsin Municipal Transport Company	145hp., 3000rpm
JZ 25	Hydraulic Articulated Frame	8.25	1-1/4-1-1/2m^3 (1-2/3-2 $yd.^3$)	2.5		6.4m. long 2.1m. wide 2.2m. high	Tientsin Municipal Transport Company	95hp., 2800rpm (maximum tractive power, 5.5 tons)
Z435	Hydraulic		1.7m^3 (2.2 $yd.^3$)	5.9				
2.7 m^3	Hydraulic		2.7m^3 (3-1/2 $yd.^3$)	5			Liu-chou Construction and Machine Plant	220hp (with accessories can be used for towing, bulldozing, excavating, earth-loosening and lifting)
8.25 m^3*	Hydraulic		8-1/4m^3 (10.7 $yd.^3$)					

* Not serially produced.

[1] Unless otherwise specified, all are serially produced, wheel type.

The Coal Industry

Overview

Lenin's phrase, "Coal is the food of industry," today still is widely quoted in China. Its truth in the Chinese context is evident from the fact that coal today still supplies about two-thirds of China's energy requirements, industry being the most important consumer. Indicative of the continuing dominant role of coal in industry and the entire economy, is the concern shown by the Chinese leadership for resolving existing bottlenecks and increasing production of coal.

A large, expanding, and practically self-sufficient coal industry has in fact been established in China. Within the space of a quarter of a century, China's coal industry has overcome its initial backwardness and foreign dependency to become the third largest in the world in terms of raw coal output. From a total annual output of 32 million metric tons in 1949 (when production about equalled pre-World War levels), production rose to an estimated 427 million tons in 1975.

Political policy has been decisive in determining the pattern of economic development, and the role of coal in it. In the 1950's, the policy was at first to model China's development closely on that of the Soviet Union. As in the Soviet Union, investment in the coal industry was heavy, amounting in the First Five-Year Plan (1953-57) to some 12 percent of total planned industrial investment. The longwall system of mining prevalent in the Soviet Union was introduced, largely displacing the then dominant room and pillar system. Emphasis was placed on the construction of large mines, heavily mechanized. The construction of coal mine machinery plants was undertaken on the basis of Soviet plans and technical advice. Soviet machinery was imported in quantity. In short, Chinese policy was to regard the Soviets as "elder brothers" and generally to follow Soviet practice.

In the late 1950's, China significantly departed from the Soviet model, taking an independent line which stressed reliance on its labor surplus to help overcome its shortage of capital. The launching of the Great Leap Forward in 1958 spawned an historically unprecedented mass movement in which millions of people prospected for coal and opened thousands of small mines. This did not mean an abandonment of large-scale modern mining, but rather its supplementation with small-scale local mining utilizing simple equipment. This dual stress on both traditional and modern technological methods, and the small as well as the large, was dubbed "walking on two legs."

In 1960, the Soviet Union unexpectedly and quickly withdrew all technical support from China, ushering in a new stage in China's coal industry policy and creating the need to develop independently of foreign assistance. As a result, China continued its small- and large-scale mining while reducing its reliance on importation of foreign equipment and technology. The diminution of the role played by foreign technology and equipment has not meant its elimination, and since 1960 China has continued to import foreign equipment.

China possesses all the physical requirements for the long-term development of a progressively larger coal industry. Reserves appear to exist in abundance although accurate data are not available. The most optimistic estimate is in excess of 10 trillion tons of coal on an inferred basis—of which at least 200 billion tons would appear to be commercially exploitable at this time. The quality of the coal, generally, is good. Over two thirds of the deposits are bituminous and a substantial portion of the remainder anthracite, with relatively small percentages of lignite and peat. The coal seams are thick, almost half being three or more meters thick, and over two-thirds have only a slight slope. Systematic exploration has shown that commercially exploitable reserves are found in all provinces, including the formerly "coal poor" south. Some rich deposits are located in sparsely populated areas, but the dispersal of industry has increased utility of these deposits.

About two-thirds of China's coal is produced at large mines, 10 of which now produce annually in excess of 10 million tons each. Small mines of under 100,000 tons annual output, however, are

thought to account for about one-third of annual production, a percentage which has held firm since 1969 because of the ongoing development of small and medium mines which number in the thousands.

China has many coal seams lying near the surface, but so far has apparently declined as a matter of policy to increase substantially the proportion of output from large open-pit mines, which numbered only seven in 1960. While the reasons for this are not entirely clear, the encroachment on agriculturally productive land, shortages of equipment, and damage to the environment may be among the major inhibiting factors.

Unlike the United States, Chinese underground coal mines normally use longwall mining systems. In 1960, of some 60 extraction methods (shown in percentage terms in Table 5) about 85 percent were basically longwall methods often used in conjunction with slicing and less than 1 percent were room and pillar methods.

The use of retreating along the strike in about half of the longwall systems indicates that China has mastered the more productive longwall technique.

Table 5.—*Coal Extraction Methods According to Chinese Classification, Early 1958*

Method	*Percentage of Output*
Longwall recreating	48.8
Longwall advancing	0.9
Layering	37.4
Room-and-pillar	0.3
Handicraft	1.1
Other (including open-pit and hydraulic extraction)	11.5
Total	100.0

Source: The Coal Industry of the People's Republic of China (Moscow 1959) p. 100. It is probable that locally controlled mines (i.e., mines other than those under the Ministry of Coal Industry) are not included in this classification.

Although the Chinese purposefully substitute labor for machinery where necessary to achieve output goals and fully tap available coal resources, vigorous efforts are made to increase labor productivity in order to lower costs, lessen the burden of heavy manual exertion, improve mine safety, and more rationally deploy available labor. In 1952, output in metric tons per man-day for all personnel in state-owned mines was 0.66 tons; by 1957 output had risen to 0.98 tons, or by 48 percent. While published Chinese data are not available today, productivity probably still lags considerably behind the advanced coal producing countries, evident from the fact that the coal industry employed 3 million workers to produce 430 million metric tons of coal in 1975. The Chinese strive to raise productivity by increased mechanization, by rational organization, and by heightened motivation of production personnel.

The dual policy of developing large and small mines decreases the degree of mechanization and productivity in Chinese coal mines compared to that in the major coal producing countries. Since 1958, mechanization in the larger mines has been intensified An overview of the coal industry in China would be incomplete without taking note of the challenge rapid oil and gas production poses to coal's role as primary energy source. Table 6 shows how coal's energy role is slipping relatively as oil and gas have become increasingly available. The projected figures for 1980 assume conservative annual growth rates for coal at 6 percent; oil, 10 percent; gas, 10 percent; and hydroelectric output, 6 percent.

Coal's continued growth over the next couple of decades, despite growing oil and gas production, seems certain for several reasons. Coal is a necessary non-substitutable resource in increasing demand by the iron and steel industry, which consumed almost 100 million tons of raw coal in 1973. Because of the inadequate transportation network, locally produced coal will continue to be the most economic fuel or raw material for dozens of small, medium-sized, and even large electric power plants, cement plants, fertilizer plants, and nonferrous metallurgical smelters. As the petroleum distribution network improves, many such industries will come to use oil or gas, but the shortage of capital will make this transfer process slower than was experienced in the United States. China may also be expected to closely examine the fuel choice of new enterprises for compatibility with overall economic plans. In the meantime, coal is still available in most industrial centers at lower costs than oil or gas.

Table 6.—*China: Production of Primary Energy* [1]

(in percent)

	Total	*Coal*	*Oil*	*Natural gas*	*Hydroelectric*
1952	100	98	2	N.A.	Negl.
1957	100	96	2	1	1
1965	100	85	8	6	1
1970	100	76	14	9	1
1974	100	67	23	9	1
1980	100	62	27	10	1

[1] Data are for coal, crude oil, natural gas, and hydroelectric power expressed in terms of coal equivalents (calorific value of 7,000 kilocalories per kilocalories per kilogram).

Coal Production

Coal production in China during 1975 is estimated to have been about 427 million metric tons, equal to 15 times the 1949 figure. Raw coal production in China in 1975 was greater than that of any other country in the world except the Soviet Union (701 million metric tons) and the United States (580 million metric tons.

Coal output in China has been growing at a 6.9 percent average annual rate over the last 10 years. Coal's solid overall growth rate reflects the strong emphasis now being given to economic development and the key role coal continues to play in this process. Current indications suggest that continued growth of coal output over the next 5 years (1976-80) at an average annual rate of approximately 6 percent appears attainable even though 1976 may see only a 3 to 5 percent growth rate. Table 7 shows coal output projected at a 6 percent growth rate from 1975 to 1980.

Table 7.—*Coal Production in China*

(million metric tons)

Year	*Output*
1936	39
1942	65
1949	32
1952	66
1957	130
1962*	180
1967	190
1968	205
1969	258
1970	310
1971	335
1972	356
1973	377
1974	389
1975	427
1976	452
1977	479
1978	507
1979	537
1980	569

* Figures for years after 1957 are estimates.

The increasing use of oil and gas in China will cause the relative position of coal in China's energy picture to shrink 5 more percent over the next 10 years. Whereas coal now supplies two-thirds of total energy, Table 6 shows that in 1980 it will supply only about 60 percent, with oil accounting for about 30 percent of potential energy production and natural gas about 10 percent. A portion of the oil coming into production is likely to be exported however.

Reserves

China's coal reserves are not known with much certainty, but all agree that they are among the largest in the world. The spectrum of estimates is extraordinarily wide, ranging from a few hundred billion tons to over 10 trillion tons. Inadequate prospecting was responsible for a series of low pre-1949 estimates which were later regularly raised as more thorough prospecting was carried out. The estimates in the higher end of the spectrum represent "inferred" or "possible" reserves. PRC publications in the late 1950's referred to "verified" reserves of around 100 billion tons. Thus it is likely that current verified or commercially exploitable reserves have surpassed 200 billion tons, with "probable" reserves of about 1.5 trillion tons and "possible" reserves, over 10 trillion tons. Even if these higher figures do not prove to be accurate, it is clear that China has adequate commercially exploitable coal reserves to meet its energy and other needs for several centuries.

Coal reserves are widely distributed throughout China. Before 1949 certain provinces and regions in southern China were considered to be practically devoid of minable coal deposits, but later surveys have shown this section to have sizable reserves even if not always in easily minable formation. The areas possessing the largest reserves are in north and northwest China, in some cases far removed from the industrial heartlands of the northeast (Manchuria) and eastern China. The distribution of coal in China is summarized in Table 8. Because it was the earliest center of heavy industry, the most productive coal region until recently has been the northeast, an area possessing reserves small in relative terms but sub-

Table 8.—*Distribution of China's Coal Reserves* *

Region	*Billions of tons*	*Precent of total*
Northeast [1]	40.2	2.68
North [2]	1,050.2	70.08
Northwest [3]	280.7	18.72
Inner Mongolia	69.3	4.62
Southwest [4]	49.2	3.28
South-Central [5]	56.3	3.75
East [6]	22.4	1.49
Total	1,500.0	100.00

[1] Heilungkiang, Kirin, and Liaoning.
[2] Hopei and Shansi
[3] Inner Mongolia, Shensi, Kansu, Tsinghai, and Sinkiang.
[4] Tibet, Szechwan, Yunnan, and Kweichow.
[5] Honan, Hupeh, Hunan, Kwangtung, and Kwangsi.
[6] Shantung, Kiangsu, Ashwei, Chekiang, Fukien, and Kiangsi.
* On a "potential" basis, from an article in *Hung Ch'i (Red Flag)*, No. 13, 1958.

stantial in absolute quantity. The mismatch between reserves location and coal production and general industrial development should not become a problem since new industrial areas are being developed in the interior.

Chinese coal seams differ widely from region to region, but generally are minable without too much difficulty. In terms of thickness, seams worked in China average a little more than two meters, which is thicker than averages in the United States (1.65 meters) and the Soviet Union (1.27 meters). Some seams, such as in the Fushun mine in northeast China, are over 200 meters thick and are among the world's thickest. Table 9 shows the distribution of Chinese coal seams by thickness. Chinese seams are steeper than those of the United States but are somewhat less sloping than Soviet and continental European seams. Table 10 shows how China's seams compare with respect to angle of dip with other countries. The average depth of seams worked in China is somewhat deep, 218 meters, much deeper than the U.S. average (63 meters), but not as deep as continental European seams.

Table 9.—*Distribution of Chinese Coal Seams by by Thickness, 1957*

Seam thinkness	*Percentage of total seams*
Up to 1.3 meters	16.5
1.3 to 3.0 meters	39.5
3.0 to 3.5 meters	4.4
Over 3.5 meters	39.6
Total	100.0

Source: *The Chinese Coal Industry*, Part 1, Sec. 4, Warrington (England), Joseph Crosfield and Sons. p. 3.

Table 10.—*China: Underground Seams by Angle of Dip, 1957*

(in percent)

Country	*Slight*	*Sloping*	*Steep*
China	69.7	22.4	7.9
U.S.S.R.	69.2	13.9	16.9
United States (coal and anthracite)	97.0	3.0	—
France	53.5	33.7	12.8
United Kingdom	80.0	20.0	—
Ruhr	63.0	9.5	27.5

Source: The Chinese Coal Industry, Part 1, Sec. 4, Page 4.

There is great potential in China for strip mining since thick seams occur in many places close to the surface. Before 1949 only one modern, large-scale strip mine existed in China, the Fushun mine in Liaoning Province. Since 1949, several other large strip mines have been developed, the most prominent of which is the Fuhsin mine, also in Liaoning. The potential for strip mining, given the favorable conditions for it, however, remains largely untapped.

Until the latter part of the nineteenth century all Chinese coal mines were small pick and shovel operations. Around the turn of the century several large mines were developed with foreign technology and management, but only a few, particularly Fushun (Japanese controlled) and Kailan (British controlled), came to be truly large by world standards, producing around 7 and 10 million ton tons a year, respectively, at their pre-1949 peaks. Small "native" mines continued to flourish even as these few large mines developed. Also, a number of mines intermediate in size and technology began to appear, usually owned by Chinese investors. The primary reason for the continued existence of the small mines was the inadequate transportation network, which made their small-scale, highly inefficient production competitive with coal from large mines transportable over long distances only at extraordinarily high cost.

The new Chinese leadership appears to have initially downgraded the importance and role of small mines. The emphasis in the First Five-Year Plan (FFYP; 1953-57) was toward construction of large mines. Large-scale shafts of more than 900,000 tons annual capacity accounted for 28.3 percent of 115 new mine shafts begun in accordance with the FFYP. Medium-scale shafts of 400,000 to 600,000 tons comprised some 32.7 percent of the total. By 1957, the 74 new shafts begun and completed during the plan period had an average annual output of over 300,000 tons per shaft. The initial emphasis on largeness may have been influenced by a desire to better utilize Soviet equipment and expertise which China used during this period on a large scale.

In 1958, China's economic policymakers modified the emphasis on largeness with the launching of the Great Leap Forward (1958-60) and the unfolding of a nationwide campaign to build small coal mines. In this period, literally millions of people were mobilized to prospect for coal and construct small coal mines or pits. The percentage of coal from small mines quickly recovered its pre-1949 proportion of the total. The scale of activity in searching for and developing small mines was reduced in the early 1960's in line with the general policy of consolidation following the economic crisis of 1960-61. But the concept of the small mine had been revived and,

Table 11.—*Output of China's Largest Mining Administrations (over 5 million tons annual output) at varied times*

(in millions on tons)

Mines	*Province*	*1952*	*1957*	*1970*
Fushun	Liaoning	10	10	20-22
Fuhsin	Liaoning	4	10	20-22
Kailuan	Hopei	6.65	6.65	17-19
Tatung	Shansi	2.34	5,84	14-16
Huainan	Anhwei	2.56	4,91	13-15
Hokang	Heilungkiang	2.18	4,89	13-15
Chihsi	Heilungkiang	3.06	5.84	13-15
Pingtingshan	Honan	—	—	9-10
Fengfeng	Hopei	1.88	3.31	6-8
Peking	Peking (Municipality)	—	—	6-8
Yangchuan	Shansi	1.37	4.18	5-7
Tzepo	Shantung	2.63	3.74	5-7

Source: U.S. Bureau of Mines.

following further encouragement during the Cultural Revolution (1966-69), output from small mines during the Fourth Five-Year Plan (1971-75) accounted for 30% of national production.

A convenient view of the rate of growth in mine size in the group of larger mines is provided by Table 11. Altogether in 1970 some 23 mines had an annual output exceeding 2 milion tons. All underground mines collectively contain more than 2,000 workfaces.

Coal Mining Technology

Quantitative information on mining methods employed in China has not been published since the 1950's. It is likely, however, that the pattern of mining methods established by the end of the 1950's has not changed significantly, except perhaps that the greater number of small mines may have caused a rise in the proportion of mines using room-and-pillar and handicraft methods.

The dominant position of longwall mining in China is almost entirely the result of a major policy decision to push this method taken soon after the creation of the People's Republic in 1949. Before 1949, room and pillar methods were dominant but were used very inefficiently. Coal recovered was reported to be only 30 percent from seams mined by room-and-pillar methods. This low productivity was undoubtedly a main reason for the switch to the longwall system. By 1952, about 74 percent of the mines under the Ministry of Coal Industry used "new methods," which meant mainly various longwall methods. Within the longwall systems the Chinese were able to make retreat mining the prevalent longwall form. Given the successes achieved with longwall, it is assumed that this method will continue into the foreseeable future as the primary system of Chinese coal mining.

Unlike current U.S. practice, the Chinese have not attempted to increase very substantially the open-pit method share of total coal production. The share of open-pit coal mines in the first decade of the People's Republic actually fell from 11.35 percent in 1949 to only 10 percent in 1958. Although a number of open-pit mines have been developed since 1958, it is likely that the proportion of coal extracted from open-pit mines has not grown significantly since then.

After a long period of time (the 1960's) during which there occurred no news of significant open-pit development, there are now signs of renewed Chinese interest. Development of an open-pit mine in Northwest China was recently announced. Also, China has placed with U.S. suppliers substantial orders for open-pit mining equipment, including trucks, blasthole drills, drill bits, and other equipment and, although intended for iron ore mine use, capable of use in open-pit coal mines. Open-pit mining may now be undergoing gradual growth, which may quicken as the transportation network grows and coal from more remote sites becomes economically transportable to industrial areas.

Hydraulic mining is another example of a system not in general use in the United States but practiced to some degree in China. Introduced for the first time into China by the Soviet Union in the early 1950's, hydraulic mining had been put in place at a few existing mines and accounted for about one million metric tons of coal output by the end of the 1950's. Since 1958, news from China on developments in hydraulic mining has been extremely scarce.

suggesting that hydraulic mining's role is still somewhat limited. Currently, annual production may be no larger than 3 to 5 million tons.

Coal Preparation

China's coal preparation requirements are enormous and growing rapidly as the steel and electric power industries increasingly demand more mechanically cleaned coal. Mechanical coal preparation capacity has grown from less than 5 million tons in 1949 to over 100 million tons at present. The growing requirements of China's steel and electric power industries for prepared coal has stimulated China's interest in acquiring advanced foreign coal preparation equipment. Demand for more efficient coal preparation equipment may be stimulated also by the necessity to clean increasingly dirty coal and coal mines produced by more mechanized methods.

China had developed the capacity to construct independently large coal preparation plants toward the end of the 1950's. Supplementing China's own efforts, the Soviet Union and Poland had also designed and helped erect a few large plants at that time. Jigging and Rheourve launders were the technologies employed. Only one of China's then functioning 46 preparation plants used heavy media technology. Little information on developments in China's coal preparation equipment technology has come out of China since 1960. An exception was the announcement this year of the development of a jet flow flotation-type cleaning machine.

Market Development Information

Decisionmaking in China

Chinese coal mine and beneficiation facilities are administered by every level of the various political subdivisions of the Chinese state, from the central government's ministry of coal industry, through the province, and down to the local production brigade. The major division is that between the generally large mines under the primary administration of the Coal Ministry and provincial authorities and the smaller, locally controlled mines. (Some mines are captive to steel, power generation, and other large consuming Chinese enterprises.) Coal industry equipment manufacturing facilities are similarly controlled by a central government machine building ministry and by local political-administrative units.

Decisions to purchase foreign equipment are arrived at through consultation between end-user entities and concerned central government agencies. A large mine desiring to acquire a major piece of foreign equipment, for example, probably first obtains approval of the Coal Industry Ministry, which would forward the request to the Ministry of Foreign Trade for proposed inclusion in the national and foreign trade plans. After this, the actual purchase would be the primary responsibility of the Foreign Trade Corporation.

Although the evidence is fragmentary, it appears that China is expanding investment in the coal industry. In line with the policy of "walking on two legs," substantial resources are being put into developing large, medium, and small coal mines and beneficiation facilities. Prospecting, which commenced during the Cultural Revolution, has resulted in major new deposits being found, including deposits in coal deficit south China. Hundreds of new individual mines of all sizes, including some large mining centers, have been constructed or are under construction.

Selling to China

All external trade of the People's Republic of China is controlled by eight foreign trade corporations (FTC) subordinate to the Ministry of Foreign Trade. The purchase of individual items of coal industry equipment is under the jurisdiction of Machimpex. The full name and address of this FTC is:

China National Machinery Import and Export Corporation
Erh Li Kou, Hsi Chiao
Peking, People's Republic of China

If the purchase is a complete coal washing or other plant, a major addition to a plant, or the technology necessary to the production of major items of coal industry equipment, the transaction will be with Techimport. The full name and address of this FTC is:

China National Technical Import Corporation
Erh Li Kou, Hsi Chiao
Peking, People's Republic of China

It is not necessary to write to individual at the trade corporations.

Doing business in China involves a considerable amount of time and money from contract to contract. Contact is made by writing Machimpex or Techimport. If the FTC has an order in hand for the equipment being marketed, the response may be quick, requesting more information or asking for a visit to Peking for further discussion. If the FTC has no requirement or order in hand, nothing may be heard.

Present during these Peking discussions, in addition to the trade corporation staff, will be representatives from the end-users of the equipment in question. Negotiations are more extensive than is normal in the United States, particularly the technical discussions where the depth has surprised many foreign businessmen. Depending on the urgency for the equipment and the price, negotiations may be expected to last from 6 months to 2 years in the case of complete plant. All contracts are with the FTC and not with the mining administrations or other end-users of the equipment.[1]

Generally, the Chinese are interested in the newest equipment and the latest technology. American corporations have already sold the latest types of some petrochemical technology to China. Although there is no patent law available to foreign firms in

[1] Additional detail on all aspects of trading with the People's Republic of China may be found in the Commerce publication, *Doing Business with China*, OBR76-43 November 1976.

China, the Chinese have shown some willingness on a case-by-case basis to give contractual assurances to limit the use of the seller's technology within China and to prohibit the reexport of the technology to third countries. It is unlikely that the Chinese will show any inerest in joint ventures at this time.

In some cases, an effective marketing channel is the trade fair. Exhibiting equipment and holding technical symposia offer some direct contact with end-users. To date, however, there have been no U.S. trade shows in China although the foreign subsidiaries of American firms have occasionally participated in such fairs. Individual U.S. companies have been able in several cases to present in-depth technical symposia in Peking.

Export Administration Controls

U.S. exports to China, the Soviet Union, and certain other destinations are subject to controls provided for by the Export Administration Act of 1969, as amended. One purpose of this legislation is to authorize controls over the export of goods and technology that would contribute to the military potential of these countries so as to jeopardize U.S. national security. The legislation also declares it to be the policy of the United States to encourage trade in non-sensitive items with all nations, including China, with whom we have diplomatic or trading relations.

For detailed information on licensing requirements, U.S. exporters should consult the "Export Administration Regulations" and supplementary "Export Administration Bulletins" at any U.S. Department of Commerce District Office in most major U.S. cities. Included in the Regulations is the Commodity Control List (CCL); this is the key to determining whether a specific shipment may be exported under an established general license, issued by the Department, as required. Most equipment for the coal industry may be shipped under general license, although some items of equipment and certain technical data will require a validated license.

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